

ELECTRIC STEERING SYSTEMS

The subject of power steering gear for small vessels has only recently been given serious consideration. Several years ago, however, Sperry became interested in this problem due to the necessity of power steering as an adjunct to the Gyro-Pilot on small vessels.

As a result of our experience with the Gyro-Pilot we applied the same control principles to the problem of small vessel steering, developing a dependable, drum-type electric steering engine in place of the power unit of the Gyro-Pilot. This steering engine can be used, either with the Gyro-Pilot, or with any of the manual steering control systems described in the following paragraphs.



FIGURE 42.
Electro-mechanical steering stand.

Electro-Mechanical Steering Stand

This unit provides follow-up, electric power steering. Should the power be interrupted, an instantaneous changeover from electric to hand steering can be effected by the man at the wheel. Without loss of control of the rudder, he can continue steering, with the same wheel as before, through mechanical shafting to the steering engine.

The steering stand is connected electrically to the steering engine control panel. For electric steering, the wheelsman turns the steering wheel in the usual manner, at any rate of speed, and with sufficient ease to permit finger-tip control. As the wheel is rotated, an electrical contact is made which actuates the steering engine motor, thereby applying the rudder in the desired direction. Simultaneously, the shafting between the steering engine and the steering stand is rotated by the engine. The rotation of this shafting provides the "follow-up" control whereby the rudder is moved in proportion to the angle through which the steering wheel is turned. By means of dynamic braking, the motor is stopped the instant that the rudder reaches the desired angle, and a solenoid-actuated shoe brake holds the rudder in position. When the steering wheel is turned again or when it is reversed, the brake instantly releases and permits the rudder to be moved. The shafting in the steering stand is geared to a pointer on the top of the steering stand, so that the wheelsman is provided with an exact indication of rudder position. The rudder indicator pointer is always in synchronism with the rudder and never has to be reset.

Follow-Up Electric Steering Stand

The Follow-Up Electric Steering System provides a self-synchronous control of the steering engine. In addition, a non-follow-up auxiliary

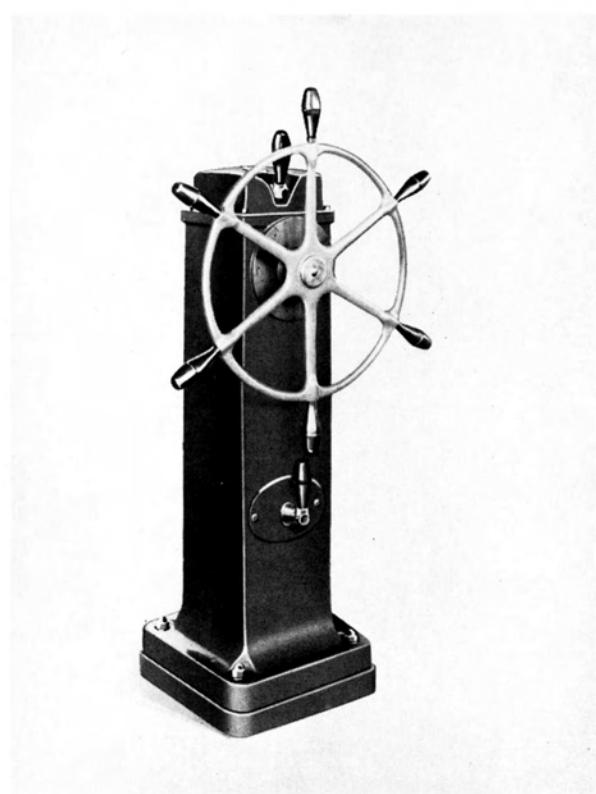


FIGURE 43.
Follow-Up Electric Steering Stand.

controller is included as an alternate method of control. The system comprises a steering stand, steering engine, control panel, and a D-C.—A-C. dynamotor. The steering stand has a non-magnetic steering column, a non-magnetic steering wheel of convenient size, and the necessary electrical contacts and gearing for controlling the steering engine. There is no shaft connection to the steering engine as there is with the Electro-Mechanical Steerer, and for this reason a repeat back system consisting of an A-C. self-synchronous transmitter and motor is used in order to obtain follow-up control. Alternating current for these motors is provided by the D-C.—A-C. dynamotor, which is usually mounted near the control panel in the engine room. This system of self-synchronous control is exactly the same in principle as the system employed in the Sperry Gyro-Pilot, which has already been described in a previous chapter of this booklet.

A rudder order indicator on the top of the steering stand, geared to the steering wheel shaft, gives the wheelsman a visual indication at all times of the amount of rudder "ordered" by the wheel.

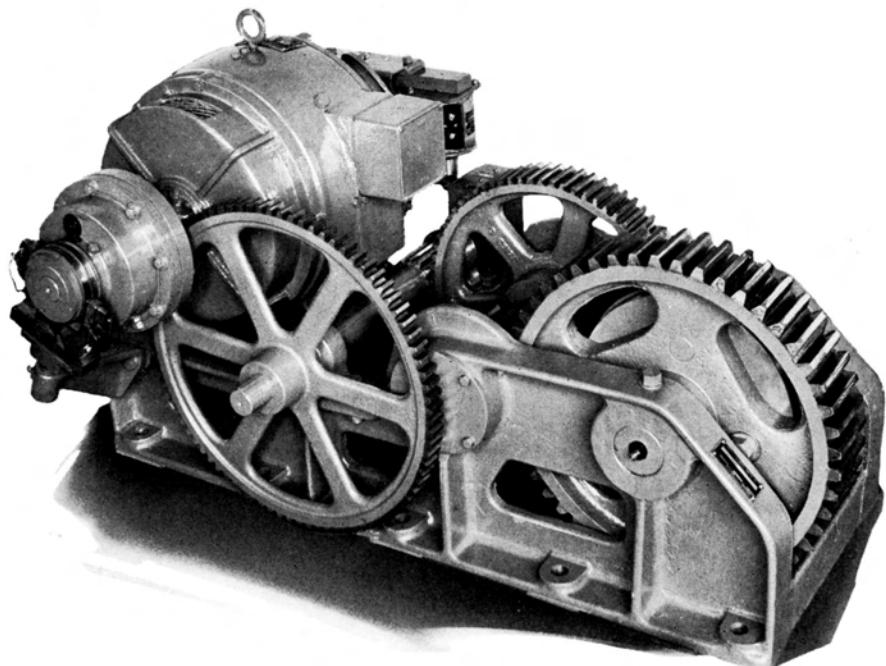


FIGURE 44.
Steering Engine.

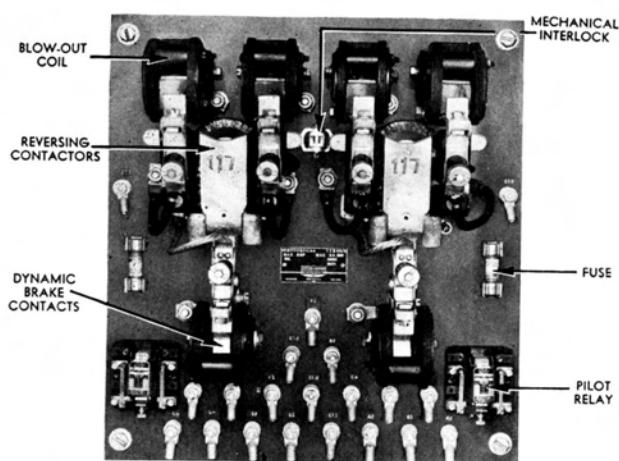


FIGURE 45.

The Motor Control Panel.

Non-Follow-Up Electric Steering Controller

The Non-Follow-Up Electric Steering System utilizes the same type of steering engine as the Electro-Mechanical and the Follow-Up Electric Systems, with the exception that no disconnecting clutch is required as is the case with the former system and no A-C. repeat back is required as is the case with the latter system. The steering controller consists of a single-pole, double-throw switch contained in a metal case and having a projecting handle or lever which can be moved to left or right in order to obtain left or right rudder. One model of the Controller has an electric rudder angle indicator which is actuated by a rudder angle transmitter. The rudder angle transmitter consists of a potentiometer mounted in a case, with the slider operated mechanically through a link connection to the rudder stock.

Steering Engine

Sperry electric steering engines are built in two sizes. The No. 1 engine has a 2 horsepower, 350 r.p.m. motor; the No. 2 has a 5 horsepower, 800 r.p.m. motor. The No. 1 engine is generally used in vessels requiring not more than 7500 lbs. maximum pull on the rudder quadrant periphery. The No. 2 engine is used in vessels requiring over 7500 but not more than 17,000 lbs. maximum pull. The engine frame and bed is a single, steel

casting. All rotating shafts are equipped with heavy-duty ball bearings.

In some ships the steering engine is bolted to the deck-beams overhead so that it will not interfere with engine room equipment.

OPERATION

Operating the electric steering systems is so simple that very few instructions are required.

Electro-Mechanical Steering System

1. Close the main supply switch (adjacent to the motor control panel).
2. Close the transfer switch (usually in the wheelhouse or vicinity) in the WHEEL STEERING position.
3. Push the selector knob (at the center of the steering wheel) *in* to the ELECTRIC position.
4. Steer in the usual manner. The indicator on the top of the steering stand shows the position of the rudder.
5. In the event of power failure, or if it is desired to steer with manual power, pull the selector knob *out* to the HAND position and continue to steer. *CAUTION:* When shifting from ELECTRIC to HAND, be sure selector knob is pulled

FIGURE 46.
Non-Follow-Up Controller with Rudder Angle Indicator.

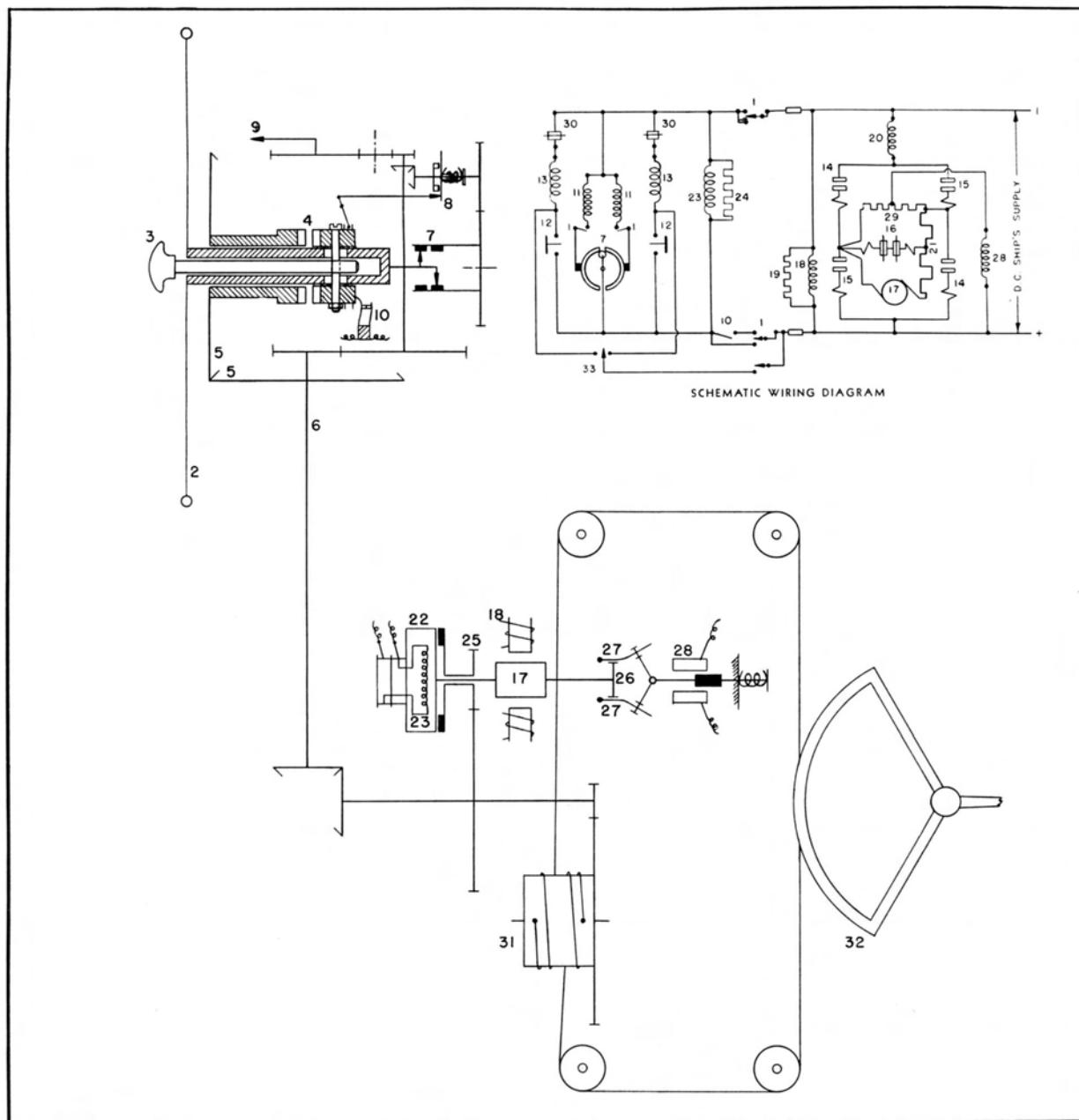


FIGURE 47.
Schematic diagram of the Electro-Mechanical Steering System.

NOTE: Selector knob shown in *Electric* position

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|-----------------------------------|-----------------------------|------------------------------|
| 1 Transfer Switch (5 Pole) | 12 Pilot Relay Contacts | 23 Clutch Coil |
| 2 Steering Wheel | 13 Main Contactor Coils | 24 Clutch Discharge Resistor |
| 3 Selector Knob | 14, 15 Reversing Contactors | 25 Clutch Disc |
| 4 Crab Clutch | 16 Dynamic Brake Contacts | 26 Brake Drum |
| 5 Bevel Gear | 17 Motor Armature | 27 Brake Shoe |
| 6 Shaft | 18 Motor Shunt Field | 28 Brake Coil |
| 7 Contact Ring Assembly | 19 Field Discharge Resistor | 29 Brake Operating Resistor |
| 8 Control Clutch | 20 Series Field | 30 Limit Switch Contacts |
| 9 Rudder Indicator | 21 Ballast Resistor | 31 Cable Drum |
| 10 Hand-Electric Interlock Switch | 22 Magnetic Clutch | 32 Rudder Quadrant |
| 11 Pilot Relay Coils | | 33 Controller |

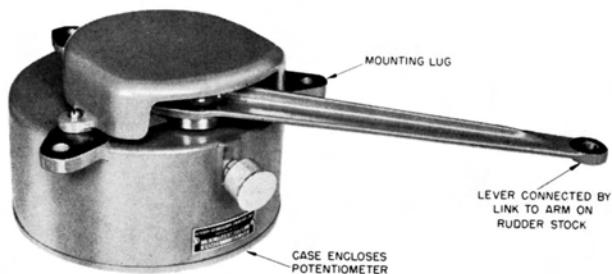


FIGURE 48.
Rudder Angle Transmitter.

out. This will facilitate engagement of the crab clutch which is necessary for manual steering.

6. When finished steering, put selector knob in its *mid-position* (NEUTRAL). This disconnects both electrical and mechanical system, so that the rudder will not be moved even if the steering wheel should be turned.

7. To secure the equipment, open the main supply switch.

Follow-Up Electric Steering Stand

1. Close main supply switch (usually in the wheelhouse or vicinity).
2. Close the transfer switch on the steering stand to the HAND WHEEL position.
3. Steer in the usual manner.

Non-Follow-Up Electric Steering Controller

1. To steer with Non-Follow-Up Controller, turn transfer switch to CONTROLLER position. As there is no follow-up action, the rudder will turn as long as the handle is held over. When the handle is returned to neutral, the rudder will stop. When it is moved to the other side, the rudder will move the other way. When the handle is released, it returns automatically to the mid-position, thereby stopping the steering engine.

2. **CAUTION:** When the controller is used in conjunction with Electro-Mechanical steering equipment, be sure selector knob at center of steering wheel is in its neutral position so steering wheel will not turn.

MAINTENANCE

Ordinarily, the electric steering equipment requires very little care. The units are very rugged, with few wearing parts. Inspection should be made at periodic intervals, however, and the various units cleaned and oiled in accordance with the instructions which follow. In this way any condition which might be a potential source of trouble can be detected at once and rectified.

Electro-Mechanical Steering Stand

With the top and forward covers removed, clean the contact rings with carbon-tetrachloride and wipe dry. Inspect the rollers and brushes to see that they are clean and free to make good contact. Keep all electrical parts and clutch faces clean and free from oil or grease.

Lightly grease all sliding parts such as splines, cams, and gears.

Saturate wicking in well over wheel-shaft with heavy medium machine oil.

Follow-Up Electric Steering Stand

Clean the contact rings with carbon-tetrachloride, and wipe dry. Inspect the rollers and brushes to see that they are clean and free to make good contact.

Non-Follow-Up Controller

Apply two drops of light machine oil to the spindle of the operating handle every two months. The contacts in the controller have a wiping action as they open and close, so as to be practically self-cleaning. Every few months, however, the contacts should be cleaned, and if roughened, should be smoothed with #00 sandpaper. The contacts are accessible after the cover of the controller case is removed.

The rudder angle transmitter (used with controllers which have a built-in rudder angle indi-

cator) has a grease cup which should be given one full turn every six months.

Motor Control Panel

Keep panel free from dust, oil and dampness. Maintain a smooth surface and easy rolling or wiping action on all contacts. If the motor reversing contacts become rough, they should be sanded smooth.

Steering Engine

The steering engine is lubricated with grease. Grease gun fittings are provided at the proper lubrication points and are identified by red circles. Grease the unit at these points every few months. Keep the large gear faces well supplied with a heavy, fibrous, heat-resistant grease.

The sealed bearings on the drive motor require no lubrication. Do not permit any oil or dust to collect inside the motor shell.

Examine the motor commutator at monthly intervals and clean it with fine sandpaper if roughened. A commutator in good condition should take on a chocolate brown color, with a smooth surface. The brushes should be kept clean and should move easily in the holders.

Directions for the care of the limit switch will be found on the inside of the switch cover.

Dynamotor

The dynamotor brushes, commutator, slip rings and windings should be kept clean and free from dust, oil or grease. Once a year the ball bearings should be removed, cleaned thoroughly, and re-greased.

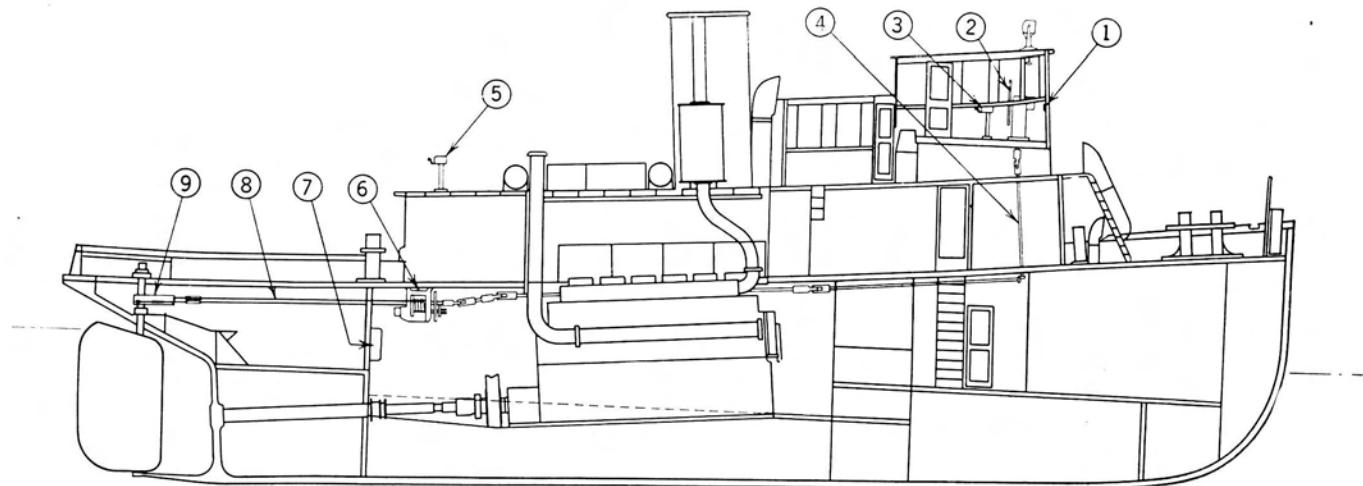


FIGURE 49.
Installation arrangement of a typical steering equipment.

1. Transfer Switch: for allocating the steering to the station selected.
2. Electro-Mechanical Steering Stand.
3. Non-Follow-Up Steering Controller, one on each side of the pilot house.
4. Shaft connection between Electro-Mechanical Steering Stand and Steering Engine.
5. Non-Follow-Up Steering Controller at steering station aft.
6. Drum-type Electric Steering Engine mounted overhead.
7. Engine Control Panel mounted on bulkhead near Steering Engine.
8. Plough steel wire rope between Steering Engine and rudder quadrant.
9. Rudder quadrant.